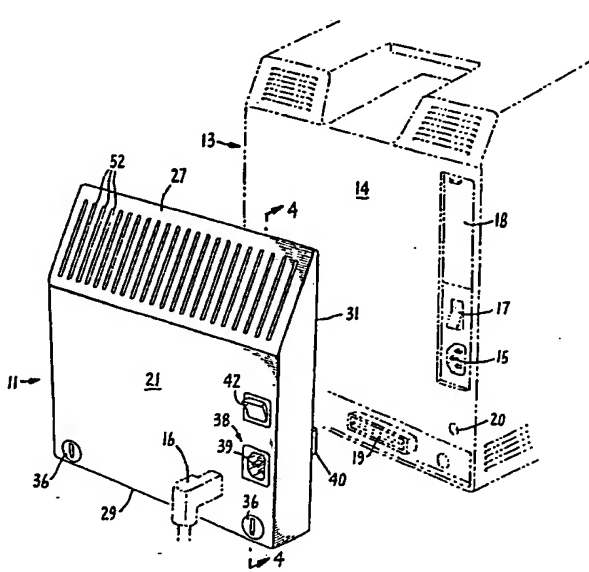


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>4</sup> :</b>  <b>G11B 5/012, G06F 1/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 89/01682</b>  <b>(43) International Publication Date:</b> 23 February 1989 (23.02.89)
<b>(21) International Application Number:</b> PCT/US88/02597 <b>(22) International Filing Date:</b> 5 August 1988 (05.08.88) <b>(31) Priority Application Number:</b> 082,639 <b>(32) Priority Date:</b> 7 August 1987 (07.08.87) <b>(33) Priority Country:</b> US  <b>(71)(72) Applicant and Inventor:</b> TRAGER, Dennis [US/US]; 542 Marine World Parkway, #4203, Redwood City, CA 94065 (US).  <b>(74) Agents:</b> PETERSON, James, W. et al.; Burns, Doane, Swecker & Mathis, Washington & Prince Streets, P.O. Box 1404, Alexandria, VA 22313-1404 (US).		<b>(81) Designated States:</b> AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).  <b>Published</b> <i>With international search report.          Before the expiration of the time limit for amending the          claims and to be republished in the event of the receipt          of amendments.</i>
<b>(54) Title:</b> ATTACHABLE HARD DISK DRIVE  <div style="text-align: center;">  </div>		
<b>(57) Abstract</b>  A hard disk drive includes a housing (11) having a wall (31) contoured to fit vertically flush against the rear wall of a cabinet (13) of a display screen for a personal computer. A hard disk drive unit (32) is mounted within the housing such that the storage disk within the drive unit is oriented generally parallel to the contoured wall. Vents (51, 52) are formed through the housing to permit air to circulate past the drive unit.		

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ATTACHABLE HARD DISK DRIVEBACKGROUND OF THE INVENTIONField of the Invention

5       The present invention generally relates to hard disk drives for personal computers (i.e, microcomputers) and, more particularly, to housings for hard disk drives that are externally connected to personal computers.

State of the Art

10       Personal computers (PC's) usually have disk drive units employing flexible or "floppy" magnetic disks for mass data storage. The primary advantage of floppy disks is that they can be easily removed from and replaced in drive units. The disadvantage of  
15       floppy disks is that their data storage capacity is relatively limited; for example, the typical capacity of a floppy disk is about 800,000 bytes of encoded binary information. An alternative to floppy disks is rigid or "hard" disks. By way of contrast to floppy  
20       disks, hard disks can store 20 megabytes or more of binary information, but are generally not removable from their drive units.

      Many PC's are sold with floppy disk drives as "original equipment", but include appropriate circuitry  
25       and connectors to receive an externally connected hard disk drive if a user needs increased data storage capacity. A disadvantage of externally connecting a hard disk drive to a PC is that the drive occupies desk space that may be needed for other purposes. To  
30       alleviate this problem, some users mount their PC atop

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hard disk drive units. Such a solution, however, is not entirely satisfactory because operation of a disk drive generates heat that may detrimentally affect a PC mounted above it. The heating problems may exist even  
5 when disk drives are equipped with cooling fans, and noise from the fans may be annoying.

#### OBJECTS AND SUMMARY OF THE PRESENT INVENTION

A primary object of the present invention is to  
10 provide an externally mounted hard disk drive for personal computers.

More particularly, an object of the present invention is to provide a hard disk drive for use with a microcomputer having a display screen cabinet with a  
15 generally vertically disposed back wall on which the hard disk drive can be mounted.

In accordance with the preceding, the present invention provides a hard disk drive generally comprising: a housing having a wall contoured to mate  
20 generally flush in vertical orientation against the rear wall of a display screen cabinet of a personal computer, a hard disk drive unit mounted in the housing with the plane of its storage disk generally parallel to the contoured wall, vents formed in the housing to  
25 permit circulation of cooling air through the housing, and means to connect the housing to the cabinet.

In one preferred embodiment, the hard disk drive further includes a connector attached to the housing to  
30 receive a main power cord for the personal computer and to provide electrical power to the disk drive unit. The connector extends through the housing and has a protruding end to engage a power cord connector on the

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cabinet of the personal computer. Also in the preferred embodiment, the contoured wall receives a power switch connected to the rear wall of the personal computer cabinet and holds the switch in the "on" position.

The foregoing and other aspects and advantages of the present invention can be readily ascertained by reference to the following description and attached drawing which illustrate the preferred embodiment.

10

IN THE DRAWING

FIGURE 1 is a pictorial view of a hard disk drive according to the present invention located for attachment to a cabinet of a personal computer display screen;

15

FIGURE 2 is a pictorial view of the hard disk drive of FIGURE 1 showing the side which attaches to the display screen cabinet;

20

FIGURE 3 is a fragmentary view, drawn to an enlarged scale for purposes of clarity, of a portion of the hard disk drive of FIGURE 2 showing an optional configuration in which is mounted screws and a tool for removing the screws; and

25

FIGURE 4 is a side sectional view of the hard disk drive of FIGURE 2 taken along the line 4-4 for viewing in the direction of the arrows, and showing the drive attached to the cabinet of a personal computer display screen.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGURE 1 shows a housing, generally indicated by the number 11, for a hard disk drive unit for a personal computer. The dashed lines in FIGURE 1 generally indicate a cabinet 13 for the display screen of a personal computer as viewed from the rear. Specifically, the illustrated cabinet is for the Macintosh Plus microcomputer manufactured by Apple Computer Co., Inc., of Cupertino, California. It may be noted that in the Macintosh Plus microcomputer the central processing unit of the microprocessor is integrated with the display terminal (i.e., is in the same cabinet).

In the illustrated embodiment of cabinet 13, the rear wall 14 includes a receptacle 15 for receiving a main power cord 16, a toggle-type power supply switch 17, and a door 18 behind which is a compartment for receiving batteries for powering the internal clock of the computer. Also mounted on rear wall 14 is a connector 19 for receiving a ribbon-type cable for externally connecting a disk drive unit to the computer.

It may be noted in FIGURE 1 that an aperture 20 is located in the lower right corner of rear wall 14. The purpose of aperture 20 is to receive a screw to connect rear wall 14 to the chassis of the computer. It should be understood that a similar aperture is located at the lower left corner of rear wall 14.

As shown in FIGURES 1 and 2, disk drive housing 11 generally includes a back wall 21, a pair of sidewalls 23 and 25, top and bottom walls 27 and 29, and a front wall 31. In practice, the walls of housing

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II are dimensioned such that housing 11 has sufficient large volume to contain a so-called "3.5 inch" (8.89 cm) disk drive generally designated by number 32. Typically, drive 32 has a surface area of about 24 square inches (154.8 cm<sup>2</sup>) and a height less than about 1.5 inches (3.81 cm). For housing such a drive, front wall 31 is about 9 inches square (58.06 cm<sup>2</sup>), and sidewalls 23 and 25 extend about 1.5 inches (3.81 cm) from the front wall. Larger disk drives, such as 5 inch (12.7 cm) drives, can be accommodated by increasing the depth of housing 11 (i.e., by increasing the extent of sidewalls 23 and 25 and top and bottom walls 27 and 29).

It should be appreciated that FIGURE 1 shows disk drive housing 11 disconnected from cabinet 13, whereas FIGURE 4 shows housing 11 mounted to cabinet 13 with the rear cabinet wall 14 flush against the front housing wall 31. To provide such mounting, the contours of housing wall 31 must generally match rear cabinet wall 14. Thus, for example, the housing wall 31 has a generally planer configuration with a recess 35 for receiving main power switch 17 on cabinet 13. In practice, recess 35 has a generally triangular shape such that power switch 17 is received in the recess only in its "on" position.

As shown in FIGURES 1-4, apertures are formed near the lower right and left corners of housing 11 in registry with the apertures 20 in rear wall 14 of cabinet 13, and threaded fasteners 36 are fitted through those apertures to connect housing 11 to rear wall 14 of cabinet 13.

In the case of the Macintosh Plus microcomputer, battery compartment door 18 has a detent to engage a

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catch in the battery compartment. In FIGURE 4, it should be understood that battery compartment door 18 has been removed and that a flexible detent member 37 is attached to wall 31 of housing 11 to engage the catch in the battery compartment. Thus, housing 11 is connected to cabinet 13 at three points as defined by the two threaded fasteners 36 and by detent member 37.

As best shown in FIGURES 2 and 4, wall 31 includes a generally rectangular protruding portion that is positioned to extend into the battery compartment behind door 18 in the rear wall 14 of cabinet 13. In practice, the rectangular protruding portion is sufficiently large to retain batteries within the battery compartment.

Referring now to FIGURES 1-4, there will be described an electrical connector, generally designated by the number 38, attached to housing 11 to receive power cord 16. The purpose of connector 38 is to provide electrical power to the display screen within cabinet 13 as well as to the disk drive unit 32 within housing 11. In the embodiment shown, electrical connector 38 extends between walls 31 and 21 of housing 11. Also in the illustrated embodiment, connector 38 includes a receptacle 39 at wall 21 to receive power cord 17 and includes a male-type connector 40 that protrudes from wall 31 for insertion into connector 15 on cabinet 13.

As shown in FIGURE 4, wires 41 lead from connector 38 to a switch 42 mounted on wall 21 of housing 11. Also, at least two wires 43 lead from switch 42 to supply power to disk drive unit 32 within housing 11. Generally speaking, switch 42 controls the flow of electrical power through connector 38. In its

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"on" position, switch 42 allows current to flow through connector 38 to power disk drive unit 32, and also to power the host computer within cabinet 13. In its "off" position, the flow of power is interrupted; thus, switch 41 functionally replaces switch 17.

As also shown in FIGURE 4, a ribbon cable 47 extends from disk drive unit 32 to a connector 49 to communicate data and control signals to the computer within cabinet 13. In the preferred embodiment, ribbon cable 47 is attached at an intermediate location on connector 49, and connector 49 has dual connector faces to allow connection of other cables so that other disk drive units can be "daisy chained" with unit 32; that is, connector 49 includes a receptacle end 49A to receive another cable connector.

As further shown in FIGURE 4 as well as FIGURE 1, air circulates through housing 11 to cool disk drive unit 32. In the preferred embodiment, the cooling is achieved convectively (i.e., without a fan). Convective flow through the housing is indicated schematically by the arrows in FIGURE 4. To accommodate the convective flow of cooling air, vent openings 51 are formed in bottom wall 29 of housing 11, and vent openings 52 are formed in top wall 27. In practice, such convective ventilation eliminates the need for a fan to cool the disk drive unit 32 while minimizing heating of cabinet 13.

As best shown in FIGURE 3, wall 31 may include recesses 55 and 56. These recesses are provided for purposes of user convenience, but are not functionally necessary. Recesses 55, for example, can be used to store battery compartment door 18. Recess 56 can be

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used to store screws removed from apertures 20 in cabinet 13 as well as to store a screw removal tool.

Although the present invention has been described with particular reference to the preferred embodiment, such disclosure should not be interpreted as limiting. Various alterations and modifications will no doubt become apparent to those skilled in the art after having read the preceding disclosure.

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WHAT IS CLAIMED IS:

1. An attachable hard disk drive for personal computers having a display screen and a cabinet with a rear wall, the unit comprising:

- 5           a) a housing having a plurality of walls, one of which is contoured to fit generally flush in vertical orientation against the rear wall of a personal computer, said wall being complementary in configuration to the rear wall of such a personal  
10 computer, the remainder of the walls of the housing forming an extension of the cabinet of such a personal computer;
- b) a hard disk drive unit mounted within the housing, said hard disk drive unit having a storage  
15 disk, the plane of the storage disk oriented generally parallel to said one wall;
- c) vent means formed through at least one other wall of said housing to permit air to circulate past the disk drive unit;
- 20           d) means to connect the housing to the rear wall of a personal computer;
- e) connector means attached to said housing to receive the main power cord for a personal computer, said connector means electrically interconnected to the  
25 disk drive unit within the housing; and
- f) a connector to communicate data and control signals to a personal computer, said connector attached to said housing and said disk drive unit.

2. A hard disk drive according to Claim 1  
30 wherein said connector means extends through the housing and has a protruding end to engage the power connector on the cabinet of a personal computer.

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3. A hard disk drive according to Claim 2 wherein said one wall has a configuration to receive a power supply switch mounted on the rear wall of a cabinet of a personal computer.

5 4. A hard disk drive according to Claim 3 wherein said configuration is contoured to hold a switch of a personal computer in the "on" position.

10 5. A hard disk drive according to Claim 4 wherein said contour is an indentation which has a generally triangular shape.

15 6. A hard disk drive according to Claim 1 wherein said one wall includes a generally rectangular protruding portion that is positioned to extend into a battery compartment in the rear wall of a cabinet of a personal computer.

7. A hard disk drive according to Claim 6 wherein said rectangular protruding portion is sufficiently large to retain batteries within a battery compartment of a personal computer.

20 8. A hard disk drive according to Claim 7 wherein said one wall has an indentation formed therein for holding a cover for the battery compartment of a personal computer.

25 9. A housing for a hard disk drive for a microcomputer or the like, said housing comprising:  
a) a first wall contoured and being complementary in configuration to fit generally flush in vertical orientation against the rear wall of a cabinet of a display screen for a personal computer having its  
30 central processing unit integrated in the cabinet with

-11-

the display screen, said first wall being complementary to the rear wall of such a personal computer;

b) top and bottom walls joined to the first wall and having vent openings formed therein to permit  
5 circulation of air upwardly through the housing;

c) a pair of sidewalls and a back wall joined to the other walls to complete a housing that forms an enclosure for a hard disk drive that is generally vertically disposed when the housing is mounted to the  
10 rear wall of the display screen cabinet of a personal computer, said top and bottom walls and said pair of side walls and back wall forming an extension of the cabinet of such a personal computer; and

d) means to secure the first wall against the  
15 rear wall of the cabinet of a personal computer.

10. A housing according to Claim 9 further including connector means to receive a main power supply cable for a personal computer, said connector means being mounted to extend through the housing to  
20 engage a main power supply receptacle of a personal computer.

11. A hard disk drive for a microcomputer having a display screen cabinet with a vertical rear wall on which is mounted a toggle-type power switch,  
25 the hard disk drive comprising:

a) a first wall contoured and being complementary in configuration to fit generally flush in vertical orientation against the rear wall of the cabinet of a microcomputer;

b) an indentation formed in said first wall and being a portion of said complementary configuration, said indentation to bias the toggle-type power switch in one position;

30

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c) a plurality of other walls joined to the first wall to complete a housing;

d) a hard disk drive unit having a storage disk mounted in the housing such that the plane of the storage disk is oriented generally parallel to said first wall;

e) vent means formed in at least two walls of the housing to permit convective circulation of air upwardly through the housing past the hard disk drive unit; and

f) means to connect the housing to the rear wall of the cabinet of a microcomputer.

12. A hard disk drive according to Claim 11 further including:

a) connector means attached to said housing to receive the main power cord for a microcomputer; and

b) switch means connected to said connector means to provide electrical power to the disk drive unit.

13. A hard disk drive according to Claim 12 wherein said connector means extends through the housing and has a protruding end to engage a socket on said rear wall of the cabinet of a microcomputer.

14. A hard disk drive according to Claim 13 wherein said switch means also includes means to control the flow of power to a microcomputer.

15. A hard disk drive according to Claim 11 wherein said indentation is shaped to hold said switch in the "on" position.

16. A hard disk drive according to Claim 11 wherein said first wall has a generally rectangular

-13-

protruding portion positioned to extend into the battery compartment in the rear wall of a microcomputer to secure batteries that may be contained in such a compartment.

5 17. A hard disk drive according to Claim 15 wherein said one wall has an indentation formed therein for holding a cover for the battery compartment of a microcomputer.

10 18. A hard disk drive according to Claim 16 further including a detent means attached to said first wall to engage an edge within a battery compartment to connect the housing to the rear wall of the cabinet of a microcomputer.

15 19. A hard disk drive according to Claim 11 further including a ribbon cable connected to said drive unit and a ribbon cable connector to connect the ribbon cable from said drive unit to the cabinet of a microcomputer.

20 20. A hard disk drive according to Claim 19 wherein said first wall includes a receptacle to receive a cable in addition to the ribbon cable from said drive unit.

1/2

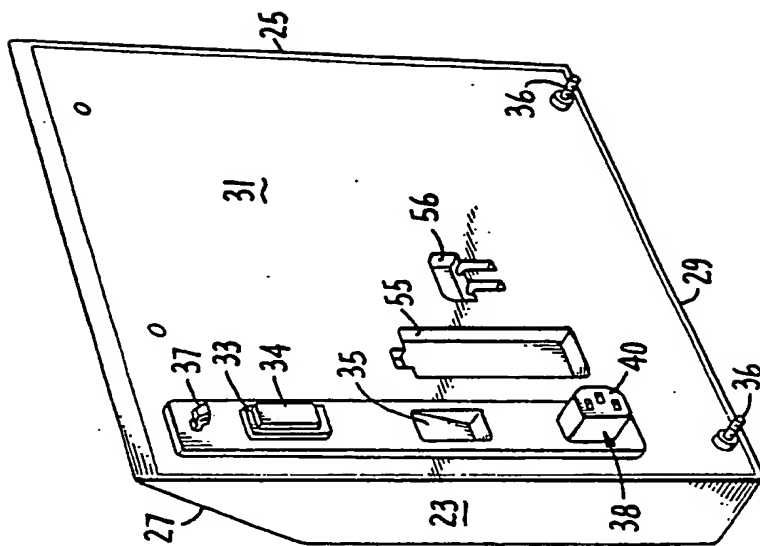


FIG. 2.

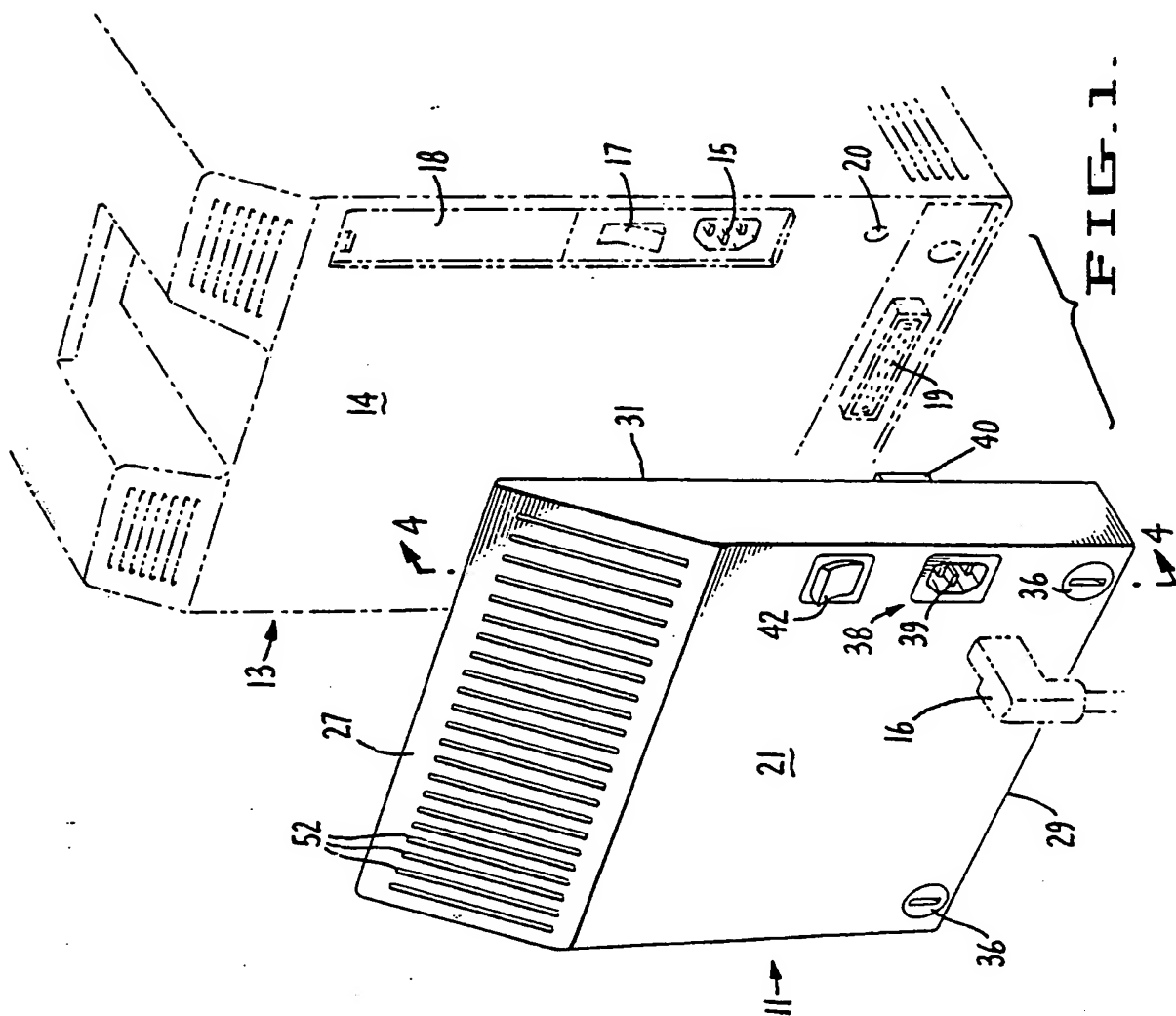


FIG. 1.

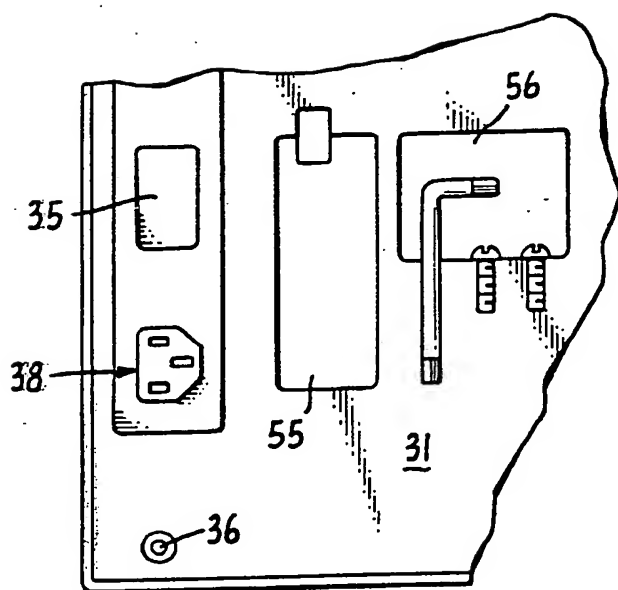


FIG. 3

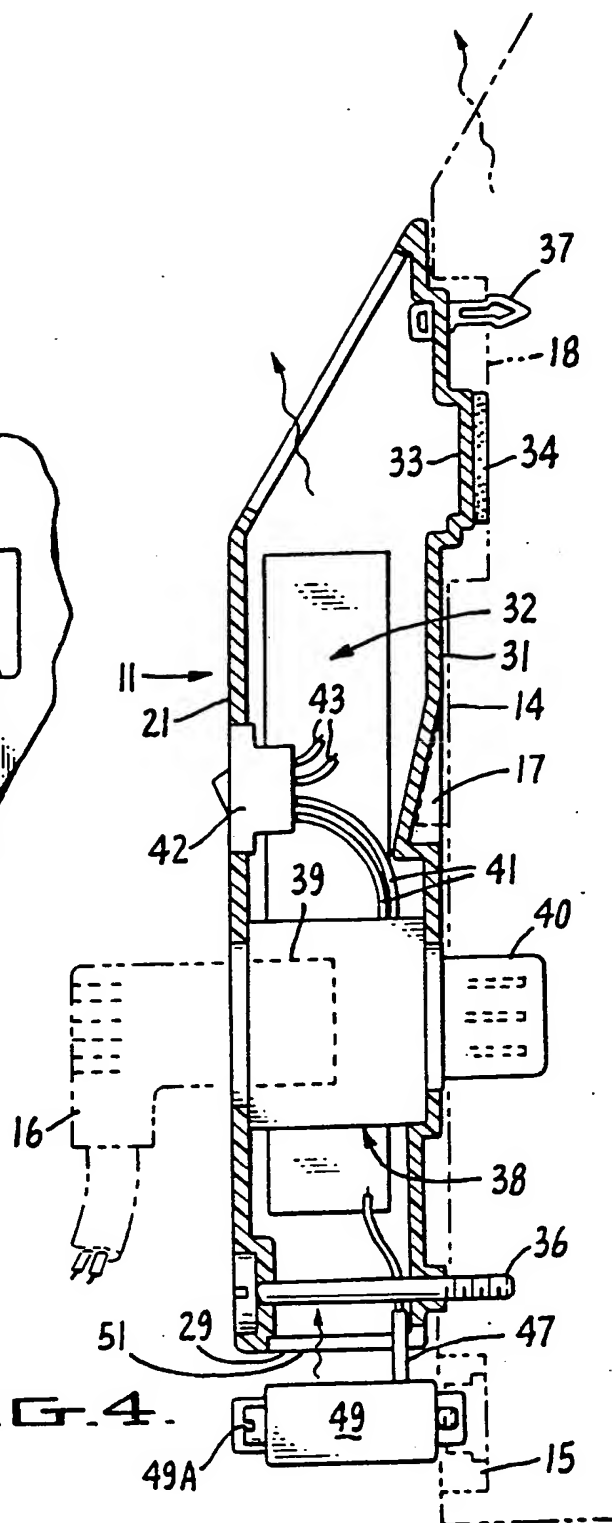


FIG. 4.

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/US88/02597

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC(5): G11B 5/012; G06F 1/00 U.S.: CL. 360/97, 137; 364/708																				
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="vertical-align: top; padding: 5px;">U.S.</td> <td style="padding: 5px;">360/97, 98, 99, 137; 364/708 361/383, 384, 390; D14/102, 106, 107, 108 312/208, 210</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div>			Classification System	Classification Symbols	U.S.	360/97, 98, 99, 137; 364/708 361/383, 384, 390; D14/102, 106, 107, 108 312/208, 210														
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<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category <sup>*</sup></th> <th style="border-bottom: 1px solid black;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 15%; border-bottom: 1px solid black;">Relevant to Claim No. <sup>13</sup></th> </tr> <tr> <td style="vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US, A, 4,669,053 (KRENZ) 26 May 1987. (26.5.87) See entire document.</td> <td style="vertical-align: top; padding: 5px;">1, 2, 9, 10</td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">Y, P</td> <td style="padding: 5px;">US, A, 4,717,982 (TORESO ET AL.) 5 January 1988 (5.1.88) See entire document.</td> <td style="vertical-align: top; padding: 5px;">1, 2, 9, 10</td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US, A, 4,479,198 (ROMANO ET AL.) 23 October 1984 (23.10.84) See figures 1, 6 and 8; column 6 lines 1-6, column 8 lines 24-40, column 9 lines 8-41 column 10 lines 5-18 and lines 55-68, column 11 lines 1 and 2.</td> <td style="vertical-align: top; padding: 5px;">1, 2, 9, 10</td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">IBM TECHNICAL DISCLOSURE BULLETIN, Vol. 28, No. 7 December 1985, "INDUSTRIAL PERSONAL COMPUTER FOR CLASS "C" INDUSTRIAL ENVIRONMENT" See figures 9A, 10A; pages 2790, 2791.</td> <td style="vertical-align: top; padding: 5px;">1, 9</td> </tr> <tr> <td style="vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3,521,010 (SATO) 21 July 1970. See entire document.</td> <td></td> </tr> </table>			Category <sup>*</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	Y	US, A, 4,669,053 (KRENZ) 26 May 1987. (26.5.87) See entire document.	1, 2, 9, 10	Y, P	US, A, 4,717,982 (TORESO ET AL.) 5 January 1988 (5.1.88) See entire document.	1, 2, 9, 10	Y	US, A, 4,479,198 (ROMANO ET AL.) 23 October 1984 (23.10.84) See figures 1, 6 and 8; column 6 lines 1-6, column 8 lines 24-40, column 9 lines 8-41 column 10 lines 5-18 and lines 55-68, column 11 lines 1 and 2.	1, 2, 9, 10	Y	IBM TECHNICAL DISCLOSURE BULLETIN, Vol. 28, No. 7 December 1985, "INDUSTRIAL PERSONAL COMPUTER FOR CLASS "C" INDUSTRIAL ENVIRONMENT" See figures 9A, 10A; pages 2790, 2791.	1, 9	A	US, A, 3,521,010 (SATO) 21 July 1970. See entire document.	
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>*</sup> Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>																				
<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of the Actual Completion of the International Search</td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of Mailing of this International Search Report</td> </tr> <tr> <td style="padding: 5px;">30 NOVEMBER 1988</td> <td style="padding: 5px;">04 JAN 1989</td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">International Searching Authority</td> <td style="border-bottom: 1px solid black; padding: 5px;">Signature of Authorized Officer</td> </tr> <tr> <td style="padding: 5px;">ISA/US</td> <td style="padding: 5px;">             ANDREW SNIEZEK         </td> </tr> </table>			Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	30 NOVEMBER 1988	04 JAN 1989	International Searching Authority	Signature of Authorized Officer	ISA/US	 ANDREW SNIEZEK										
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